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Teacher's Manual

Environmental Concerns

THE WORLD

Robert E. Sweeney

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Teacher's Manual

Environmental Concerns

THE WORLD

Robert E. Sweeney

Harcourt Brace Jovanovich
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PREFACE TO THE TEACHER

These days we celebrate the ritual of doom and gloom. We have, we despair, strontium-90 in our bones, DDT in our fat, iodine-131 in our thyroids, mercury in our nerves, asbestos in our lungs. If organisms of the past, now fossils, died of the things which made them great, are we not to die of that which has made us great—our technology? We may indeed despair. But what use is hopelessness to teachers whose main armament is hope; otherwise they would not teach.

Pollution of the environment is not new. In times past, as one example, pollution by bacteria decimated populations. People decided this could not be. And bacterial pollution—the great killer—has been conquered. Now we are faced with different assaults on the environment.

There are several views of man, but two that dominate were framed by Shakespeare so long ago.

One—brutal, biting:

> . . . man, proud man,
> Dress'd in a little brief authority,
> Most ignorant of what he's most assur'd,
> His glassy essence, like an angry ape,
> Plays such fantastic tricks before high heaven
> As makes the angels weep . . .

The other—full of hope and purpose:

> What a piece of work is a man! How noble in reason! How admirable
> in action! How like an angel in apprehension! How like a god!

It is to the latter we need repair. Our stock as teachers is reason, evidence, judgment, compassion, and above all, purpose. What man can do, he may undo. His technology has advanced our cause, but we have found it can also destroy. Can it not also repair?

A quarter of a century ago the story of population, pollution, pesticides—progressive assaults on the environment—was being told. Few, so very few, listened. This is no longer true.

Governments—federal, regional, local—have awakened to the dangers and have become active. Not fully active, true. Citizen groups have sprung up to join those already in the field. There is no doubt that the public is beginning to look to its welfare.

But what is more, schools have begun to assess their roles. After all, schools are agents of society. Teachers are in the service of civilization.

A nation that has no future need not conserve its resources. But a nation's resources are not limited to its air, water, land, fuels, minerals, and inexhaustible sunlight. A nation's wealth is not only its renewable, nonrenewable, and inexhaustible resources. A nation's foremost resource is its people; that is to say, its society, that is to say, society's wellspring, its children.

Education may be defined as the conservation of a nation's primary resource: its future—its children. And it is to the teachers who conserve children and so in turn assure a sanative environment fit for all life that this attempt at conservation, this book, is dedicated.

Paul F. Brandwein

formerly Co-Director
The Pinchot Institute for Conservation Studies

formerly Director of Education
The Conservation Foundation

TOWARD ENVIRONMENTAL EDUCATION

Though teachers, developers of curriculum, ecologists, and many concerned citizens agree about the need for environmental education, there is little agreement about what should be taught and how to teach it. Some groups approach environmental issues in an emotional way. They deplore the degradation of the environment but offer few realistic solutions to problems. Some groups concentrate on one problem area, such as population, and ignore others, such as economic growth. Still others recognize damage to the environment but argue that technology can repair it. According to another school of thought, environmental problems require a multi-phased attack. This latter group emphasizes the need for awareness and understanding of all the variables that make up our ecosystem.

Environmental Concerns: The World supports the multi-phased attack. That we are totally interdependent with the environment is an inescapable conclusion. If we destroy our environment, we may, in essence or in fact, destroy ourselves—perhaps all life on earth. Understanding the factors and forces that operate in our environment and the effect of our actions on the operation of those factors and forces is fundamental to environmental education.

There is another essential element in environmental education. In the words of Mark Terry: "The art of asking good questions and the science of answering them—these must be the aims of any education. Bringing our antique environmental assumptions into question, and beginning to develop the science that can provide better assumptions, these must be the aims of environmental education."* *Environmental Concerns: The World* equips students to evaluate the environmental choices that are open to them. The evaluation process includes recognition of values held by the individual and of the logical implications of actions the individual proposes. Finally, environmental education should inspire confidence in the individual that he or she can work to improve the environment. In other words, environmental education should pursue cognitive and affective goals simultaneously.

Cognitive Objectives

In working with *Environmental Concerns: The World* students develop learning skills and inquiry skills by analyzing case studies that deal with environmental problems and by using a decision-making process to evaluate alternative solutions to the problems. These skills enable students to attack appropriately the problems and environmental decisions they may encounter outside of school. Students also acquire basic ecological concepts, facts, and generalizations, which they may then bring to bear on new problems.

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*From *Teaching for Survival* by Mark Terry. Copyright © 1971 by Mark Terry. Ballantine Books, Inc.

Students work with an analytical model for decision making. This model involves a hierarchy of cognitive skills: comprehension, translation, interpretation, extrapolation, application, analysis, synthesis, and evaluation. The model can be divided into the following steps:*

1. Define the problem to be solved. This process includes understanding the problem thoroughly, deciding what goals should be reached, and recognizing the values implied in the decision.
2. State as many ways as possible to reach the goals.
3. Evaluate carefully the probable effects that each possible solution might have, discarding those that seem impractical or harmful.
4. Choose the policy that appears likely to achieve most of the goals aimed for, remembering that no policy is perfect.
5. Review the choice to see whether the setting of the problem has changed and whether the goals and values of the decision-makers have remained the same.

Affective Objectives

Objectives in the affective domain include the clarification of values and the development of a positive self-concept.

Values-clarification activities provide students with a means to examine, clarify, and define their attitudes and values in regard to the environment. Students consider dilemmas dealing with such questions as industrial growth versus pollution, local needs versus global needs, and choices an individual can make that will affect the environment (purchases, actions). You may suggest positive types of action an individual or group might take to solve the dilemma and encourage students to formulate solutions of their own. The students then give reasons for their selections. By focusing on reasons for selecting a particular alternative, students become aware of the values and attitudes they hold.

Teaching for values clarification does not imply the inculcation of a values system or any other form of coercion. Rather, each student builds his or her own values system.

Involving students in a variety of experiences related to environmental decision making and problem solving encourages positive attitudes toward self, environmental concerns, and school. These experiences concentrate on independent work, values clarification, decision making, and related activities that stress awareness of the environment and inspire students' confidence in their ability to influence change.

Environmental protection calls for individual action and commitment. The classroom provides an appropriate setting for examining the problems, the issues, and the alternative solutions to many ecological dilemmas. Once viable solutions are found, students can—to whatever extent they wish—participate actively in implementing the solutions. Students can practice ecology at home and in school. They can write letters, join environmental organizations, enlist community support in solving local problems, and create their own environmental organizations for the purpose of involving others.

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*From *A Rationale for the Second Edition of the Holt Social Studies Curriculum* by Edwin Fenton. Copyright © 1971 by Holt, Rinehart and Winston, Inc. Reprinted by permission of the publisher.

THE STUDENT'S TEXTBOOK

In *Environmental Concerns: The World,* varied case studies help students see the world as one environmental system and discover that decisions made at the local level have global implications.

Environmental Concerns; The World consists of three units. In Unit 1, "Quality of the Environment," students evaluate the environment in terms of the quality of life it permits. They learn ways of studying trends in the world environmental system, using the concepts of limit, linear growth, exponential growth, and doubling time.

In Unit 2, "Stresses in the World Environment," the world environment is examined in terms of five interacting factors: industrial production, pollution, population, food production per person, and resources. Case studies reveal that the interaction of these factors make up our current environmental dilemma. The first three factors are growing at unprecedented rates, while the last two factors are dwindling at equally rapid rates. In the final case study of this unit, students examine computer forecasts of coming environmental crises.

Unit 3, "The Choices Ahead," offers possible solutions to stave off the crises that have been forecast. There are case studies of the so-called "industrial solution," "technological solution," and "equilibrium society." Students explore the possibility of changes in our values and our attendant behavior toward the environment. They also explore ways in which they can participate in environmental decision making.

Each chapter within a unit begins with a brief introduction that provides orientation for the student. The introduction includes questions that lend direction to the student probes that follow. The questions may be used as study guides by the students, or they may serve as a framework for classroom lessons.

The materials for student probes were selected on the basis of students' needs and interests. The materials are primarily case studies, though only a few are written in the form of a traditional case study. They include articles from newspapers and magazines, photographs, graphs, charts, and expressions of the different points of view in environmental controversies. All of these materials require analysis and interpretation by students, and they provide the evidence needed for solving problems.

The materials are taken from a wide range of sources. After all, students obtain information from a great variety of sources in their lives outside school. They must make decisions and solve problems in "real life" on the basis of data presented in various types of media.

The materials will help students identify and empathize with individual accomplishments and commitments. Students more willingly attack problems when they can see a direct connection with situations and events in their own lives.

Two features that foster the simultaneous pursuit of cognitive and affective objectives are found with the student probes. The first, marked with the symbol ✢ , alerts students to a photograph or a marginal note that provides additional or enriching information. The second, marked with the symbol ▶ , accompanies a question that provides experiences for values clarification. The question may be found in the margin or with a photograph or group of photographs.

Following the probes is a section "To Consider and Discuss." This section contains a provocative question that extends the previous probes to a broader issue or to the students' own lives. This section can be used as the basis of a class discussion, student reports, or written assignments.

The chapter concludes with a section "Individual/Small Group Activities." These activities provide additional outlets for students who display interest in specific topics and wish to explore concepts more deeply. They also allow for independent work and individualized learning. The activities include writing letters, conducting public opinion polls and interviews, writing reports, circulating questionnaires, making drawings and collages, collecting evidence of various types of activities that result in pollution, and investigating efforts to protect the environment. These activities allow students to become directly involved in environmental change.

TEACHING STRATEGIES

A variety of teaching methods can be successfully employed in teaching *Environmental Concerns: The World.* These methods include use of exposition, problem solving, individual and small group work, role playing, directed discussion, and out-of-class activities. Indoctrination techniques should, of course, be consciously avoided. Instead, strategies that foster student questioning and the use of inquiry skills should be stressed. You, as the teacher, provide tools necessary for individual problem solving and decision making.

You may wish to extend the understandings by inviting community leaders, public officials, and other concerned citizens to speak to students about local environmental problems.

Lesson Plans

The lesson plans that follow are provided as a guide. You will, of course, wish to adapt the plans and suggested strategies to the needs of your class.

Each lesson plan deals with a separate cluster of probes and includes objectives for the probes. Various types of instructional strategies are found under the heading "Suggested Teaching Strategies." Suggested responses from students are found under the heading "Possible Student Responses." These student responses are not intended to be all-inclusive; many other valuable responses may occur and should be encouraged.

The plans assume that students have read the materials before each class. You may prefer to have students read selections in class, depending on students' abilities, time available, and other factors. You may also prefer to assign some activities for written reports rather than for class discussion.

Since the lesson plans emphasize class discussion and small group activities, you may wish to arrange desks in a circle. You may also find it helpful in maintaining the focus of a discussion to list problems, causes, and alternative solutions on the chalkboard.

Evaluation

Environmental Concerns: The World focuses on a variety of environmental problems, case studies, and open-ended questions that defy simplistic solutions and "right" or "wrong" answers. For this reason, no formal testing program is provided. Instead, you may wish to design your own testing program to meet the needs and interests of your students. The objectives in each lesson plan and the questions in the textbook should be helpful in designing the tests. Observation of students in the classroom will also aid in evaluation. Another technique you may want to use is to ask students to apply the problem-solving model to case studies of local or regional environmental problems. If you wish, you might also evaluate students' knowledge of facts, concepts, and generalizations by use of the introductory questions and the questions in the section "To Consider and Discuss."

UNIT 1 QUALITY OF THE ENVIRONMENT

1 Quality of Life

Textbook pages 2–12

Developing Inquiry Skills

To distinguish observation from inference in interpreting photographic evidence

To develop conclusions about environmental quality from the evidence

To hypothesize about the relationship of environmental quality to quality of life

Developing Learning Skills

To translate visual evidence into verbal form

Knowledge Goals

To discover that human needs are met by a variety of environments and institutions

To conceptualize that quality of life is shaped by the interactions of human institutions with the environment

To relate the utilization of resources to environmental quality and, in turn, to quality of life

Clarifying Values

To judge quality of life in terms of the values of people living in that environment and then in terms of one's own values

To begin to formulate criteria for rational use of the environment on the basis of desired quality of life

Developing a Positive Self-concept

To feel able to communicate value judgments in a group exchange

Suggested Teaching Strategies

One way to begin might be to raise the question: If you could move to a new environment, what kind of environment would you choose to assure a good quality of life for yourself? *Or:* If you could take a photograph communicating your ideal quality of life, what would it contain?

To help students bring their own values to the surface in this discussion, you can turn their attention to the case study of quality of life, on textbook pages 4–7. Have students imagine themselves in each environment

Possible Student Responses

A diversity of student responses, rather than consensus, emphasizes that decisions about environmental health and quality of life are value-laden.

Judgments of life in industrial and agrarian societies should be tested against the evidence. Students may discuss whether an agrarian society is necessarily tied to the minuses of poverty and hunger and the pluses of less tension, cleaner water and air, and more sunshine. They can note, for example, the signs of crowding and change in Nigeria (page 4). Students

Suggested Teaching Strategies	**Possible Student Responses**
pictured: How would you make a living? go to school? spend your leisure? What would your home and food be like? your expectations for the future? How much of the natural environment would you enjoy? What aspects of life in this environment would you want—or *not* want—in your own? How do you think people living in this environment feel about their quality of life? Why do you feel differently from them (if students do)? Would an assembly line worker (page 7) want to change places with a worker in one of the agricultural communities? Why? What would the former probably miss in an agrarian society?	can also consider whether an industrial society is always connected with the minuses of a deteriorating environment and "heart attacks and ulcers" along with the pluses of more food, medical care, and physical comforts. They might debate whether the unfavorable aspects of each society can be modified without losing the favorable ones and, if so, how.
At this time you might call attention to the cartoon on page 12. Is measuring quality of life a real possibility? Perhaps point out that at least two studies measuring quality of life have been attempted. (See NOTE on next page.) You may wish to ask all students to develop the simple measures of quality of life called for in the second activity on textbook page 12, while asking for volunteers to develop a more precise rating scale.	Students may evaluate quality of life in terms of economic, environmental, political, health, educational and other social factors. In one professional study, such qualitative factors were judged by subdividing them into over 100 quantitative factors. For instance, health was judged in part by infant mortality statistics; social mobility was judged partly by the number of motor-vehicle registrations.
Students can now turn to the second photographic case study, on pages 8–11. Here the need to set up standards of rational use before judging the scenes should be made clear. One way to do this is to point out that some of the environments pictured are supporting the lives of only small groups of people. The same land, paved over and industrialized, might conceivably support 5,000 people. Which would be more rational use? Is one of your criteria for rational use the number of people an environment can support? If so, what problems might arise in the transition to industrialization that could make for "irrational" use? What other criteria for rational use would you set up?	Students will probably agree even less on what constitutes rational use than on quality of life. Some might feel, for instance, that weaving a home with local reeds is rational use of local resources. Others might point out that coal, oil, and other resources may be underfoot and going unused in that environment. Students will find that their decisions on rational use depend upon their values regarding quality of life as they point out the "good" things each use of the environment brings or the "good" things that are forfeited.
Students may be asked to judge rational use of an environment not only from their own frame of reference but also from the frame of reference of the people in that habitat.	Students might, for example, view handicrafts and traditional cultivation practices as rational use of resources in an environment that lacks trade and technologies dependent on capital.

Suggested Teaching Strategies	Possible Student Responses
The class could now be divided into small groups to consider the three questions on textbook page 2. Each group reports back to the class its areas of agreement and disagreement.	Students may develop various hypotheses for Questions 2 and 3 and use evidence from the photographs or from their own background to support their hypotheses.

NOTE: The study QUALITY OF LIFE INDICATORS IN THE U.S. METROPOLITAN AREAS, 1970, *published 1975, may be obtained from the Midwest Research Institute, 425 Volker Boulevard, Kansas City, Missouri 64110. A brief report, "The Quality of Life Here is Rated High in Survey," appeared in the* NEW YORK TIMES, *October 21, 1973. Students might be curious to compare their work with these studies.*

2 Four Environmental Concepts

Textbook pages 13–20

Developing Inquiry Skills

Given the evidence, to infer the types of changes occurring in a system

Developing Learning Skills

To interpret data organized into tables and graphs

To compare the usefulness of different forms of organizing data

Knowledge Goals

To distinguish linear growth from exponential growth

To anticipate critical periods in exponential growth by applying the concepts of doubling time and halving time

Clarifying Values

To begin to weigh some of the costs versus benefits of various kinds of exponential growth

Developing a Positive Self-concept

To gain confidence in the ability to interpret complex phenomena

Suggested Teaching Strategies	Possible Student Responses
Class discussion of the three questions on textbook page 13 can be used to review the differences between linear and exponential growth developed on pages 14–16. A vivid example of exponential growth you might present is the chain letter. Each person contacted is supposed to make, for example, three more contacts. The growth in number of people contacted would then be 1, 3, 9, 27, 81, and so on. Analogous to the chain letter is the spread of rumor or gossip, or the spread of panic when	To support their explanations for Questions 1 and 2, students can offer examples from the biological, physical, and social sciences, as well as from the textbook. In the social sciences, students can assume exponential growth of a variety of factors during most periods of rapid social change—in which traditions and laws fail to provide brakes on development or behavior. A physics student might explain, as exponential growth, the chain reaction that takes place in nuclear fission.

Suggested Teaching Strategies	Possible Student Responses
someone calls fire. The behavior of one person affects several others each time, resulting in an exponential increase in the number of contacts.	The importance of understanding doubling time (Question 3) is to be able to anticipate the doubling period in which exponential growth reaches crisis proportions.
In the case studies on pages 17–19, students consider the impact upon the environment of different forms of exponential growth. You will want to have students examine the graphs in the case studies in a methodical manner to help them acquire skill in organizing and presenting their own data. What kind of data is being presented? What is the source of the data? Is the source reliable and/or how can the data be verified? To what extent does the data support or contradict the writer's assertions? What additional data, if any, would be desirable to validate the writer's conclusions? Is this a good way of presenting the data, or would another form (perhaps a bar graph or a table) be clearer?	Students should first explain the units used in each graph. A volunteer can probably explain the unit of electric power used in the graph on page 18. Household use of electricity is usually charged in kilowatt-hours by the electric power company, a kilowatt meaning 1000 watts. Industrial use is usually charged in megawatt-hours, a megawatt meaning 1 million watts, a much larger unit. Students can determine that the source of a graph or table may not appear with the graph but may be credited in the front or back of a book.
Students can be encouraged to develop a variety of hypotheses for the final, broad question in each case study. In the case study on urban growth on page 17, students might tend to apply all problems of current cities to future cities. To spark other approaches, you could ask whether these problems are inevitable. You might inform students that in Europe climate control legislation is one way of keeping cities livable in spite of rapid industrial growth. A law in Stuttgart, Germany, for example, requires that concrete parking lot grounds be interwoven with squares of grassy soil. Among other benefits, the soil reduces heat retention by the ground during summer nights. Able readers could be asked to do library research and report on other approaches to making growing cities livable.	In the case study about electric power (page 18), students may cite the following factors needed to make enough power available by the year 2000: capital invested in machinery to generate and transport electricity; a source of energy (whether nuclear or other energy) to convert into electric energy; perhaps greater consolidation of people into cities to ease the transport of electric power to them. In the case study about lake water (page 19), students can point to many adverse changes resulting from the evaporation of water. For example: As the water evaporates, minerals in it become more concentrated; the shallower water responds to seasonal temperature changes differently than the deeper water. Any such change may harm animals and plants adapted to different conditions.
You could conclude by having the class carry out the activities on page 20. In considering the first question, students should reason beyond the obvious prediction that there will be too few resources and too many people. Too	Predictions may range from very pessimistic to very optimistic. For example, on the pessimistic side: Growth of the affluent nations will be slowed; growth aspirations of the developing nations will be balked;

Suggested Teaching Strategies	Possible Student Responses
few resources for whom, and for what purposes? And, if so, what then? What current events lend weight to your prediction? Is the relationship between population and resources as formulated in this question a fact or a forecast? Is it likely to "remain unchanged," as assumed in the question? Why, or why not?	nations will need to limit their populations; life styles that depend on these dwindling resources will need to change; political and military scrambles for limited resources will take place. On the optimistic side: Technological breakthroughs will reduce dependence on these resources; close international cooperation will result in sharing of limited resources.

3 The Concept of Limit

Textbook pages 21–26

Developing Inquiry Skills

To hypothesize about the consequences of exponential growth in a system governed by limits

Developing Learning Skills

To interpret interrelationships from data presented in graphs and tables

Knowledge Goals

To probe the relationship between finite supplies and exponentially growing demands upon these supplies

To become aware of current environmental problems arising from dwindling supplies and increasing demands

Clarifying Values

To begin to consider whether curbs should be placed on the use of finite resources

Developing a Positive Self-concept

To feel able to participate with others in clarifying an environmental problem

Suggested Teaching Strategies	Possible Student Responses
You might begin by asking: Why is the concept of limit important in studying the world environment?	Students can generalize that the concept of limit is important today because people are placing increasing demands upon the environment in the face of the finiteness of that environment.
During this discussion, you can have students read or review "The Unexpected Crisis," on textbook page 22. Students could be asked to explain: What limits may eventually curb the population growth taking place in Country X?	In discussing page 22, students can begin to speculate about the varieties of growth—in industrial production, food production, and so forth—that must take place along with population growth. Growth of any kind implies use of some resource. If a resource is finite, then growth will of necessity be limited by its availability.

Suggested Teaching Strategies	Possible Student Responses
Students can then be asked to analyze the graph of petroleum use, on textbook page 23, by responding to the accompanying questions.	An exponential increase in use of petroleum is taking place. Known supplies of petroleum are the physical limit to this growth. In 1975, there were about 1700 billion barrels, but if exponential increase in use continues, supplies will run out by about the year 2000. This forecast is based on the assumptions that there is a fixed supply of petroleum and that exponential increase in use will continue. Students may speculate that more reserves will be found, that we may curb our use of petroleum, and/or use alternate forms of energy.
Now you may want to ask students to turn to textbook pages 24–25 to answer the questions that accompany the two graphs on water supply. After the specific questions, students can be encouraged to debate freely the general questions in the last paragraph of this case study. It may be helpful to raise the possibility of technological "solutions" to water shortages, such as desalination of ocean water, or cloud seeding to produce rain in the watershed that supplies the reservoirs. Reserving pure water for drinking has been offered as another partial solution. Volunteers might look into the practicality of proposals for dealing with water shortages and report to the class later, during work on pages 80–89.	The Fall River graph shows 9 million gallons a day available since 1900. Average daily demand in 1900 was about 3.8 million gallons. Demand increased steadily and, at times, exponentially, in 1900–22 and 1935–60. The limit for this growth was the safe yield of 9 million gallons a day, exceeded in about 1949. The Fitchburg graph shows a daily supply of about 2.15 million gallons in 1900. Average daily demand was about 2.8 million gallons. Daily demand exceeded supply in 1900–05, 1911–15, 1948–55, 1960–64. During the first three periods, new reservoirs were built to meet demand. But since 1964, supply has met demand only because of an exponential fall in demand.
At this point, perhaps call attention to the graph of two animal populations, on textbook page 26, and have students discuss the questions accompanying it. You may want to stress that this graph reveals a somewhat different concept of limit than revealed by the graphs of water supply and petroleum supply. This graph of predator-prey populations shows a natural process which is self-regulating. In the other cases, no such natural regulatory controls exist. The appetite of human beings for the products of nonrenewable resources is seemingly limitless, although the resources are not. Therefore we may be facing severe resource shortages unless intelligent planning and conscious self-regulation is undertaken.	In most of the time intervals, but not all, an increase in the hare population is followed by an increase in the lynx population. This data suggests a predator-prey relationship between the two animals. Students can surmise that, in general, when the hare increase, the lynx which prey upon them have a good supply of food and, after a time, also increase. But once the lynx increase, the hare, which are their prey, begin to die out. This reduces the supply of food for the lynx population, which begins to go down again. When it goes down, the hare population can increase again, and the cycle starts to repeat itself.

UNIT 2 STRESSES IN THE WORLD ENVIRONMENT

4 Using The Commons

Textbook pages 28–36

Developing Inquiry Skills

To assemble evidence of the need for changed behaviors toward the commonly owned land, water, and air

To hypothesize about the function of laws restricting the disposition of private as well as public property

Developing Learning Skills

To extract evidence from a variety of case studies and to generalize from their common elements

Knowledge Goals

To relate the quality of local environments to events in distant environments

To distinguish between harmful and beneficial behaviors toward the environment

To relate the management of wilderness areas, the oceans, and national forests to the preservation of a healthful environment

Clarifying Values

To begin to consider one's actions in terms of their effect upon the environment

To explore one's attitude toward environmental protection laws that may be personally costly or inconvenient

Developing a Positive Self-concept

To begin to accept responsibility for the wise use of public and private property

Suggested Teaching Strategies

It has been said that "What belongs to everyone belongs to no one." Students might be asked to interpret the saying before they turn to the four case studies. Does the saying seem to apply to each case study? If so, how?

Another way to begin could be the values-clarification question about the commons on page 29 of the textbook.

Possible Student Responses

Students may point out that we usually take good care of our own belongings but are less concerned about damage to public property. The case studies reveal that such nearsighted behaviors toward the commons may bring short-term benefits but often long-term harm.

Students can infer from the case

Suggested Teaching Strategies	Possible Student Responses
Either beginning can lead to the question: Why is it important to take care of public as well as private property?	studies that so-called public properties, such as air and water, should be thought of also as private properties, for they became incorporated into our very bodies, affecting health and survival.
The case study on pages 30–31 can be used to point up the complexity of decisions about land use. The class might probe into a specific public area such as a local park, public square, or real estate containing public buildings. Is this land being used wisely? Should it remain as is, or be converted to other uses? Would it be best used for housing? industry? schools? open space?	If there are controversial development projects or urban renewal projects in your area, students might explore the issues, the groups involved, the actions taken, and how final decisions about use of this land will be made. Students can begin to recognize that decisions about land use are part of the political process with input from many special-interest groups.
The class might also be asked: What are some of the laws restricting use of private property? What is their purpose?	Students might mention zoning laws separating industrial from residential areas, curbs on building heights, incinerator regulations, and so on. Students can explain how curbs on the use of private property protect the quality of air and other aspects of public property.
In the case study, "Vanishing Ocean Animals," the values-clarification question about protecting whales (page 32) can be used as the springboard for a broader discussion of the conservation movement: What is the purpose of protecting wildlife in general?	Responses will probably include the practical (we need fur and other products of wildlife); the esthetic (they're beautiful); the ecological (because of interdependence, the balances in a community become upset if some species die out).
In the discussion of protecting wildlife, you might emphasize that when wildlife suffers, it may well be a sign that some environmental condition exists that could be hazardous to people as well. Natural areas with thriving wildlife can thus serve as "environmental monitoring systems." Wilderness areas can also serve as "sample stations." That is, the quality of their water and air can be used to compare the extent of deterioration of water, land, and air in cities and farmlands, and the effectiveness of our pollution control programs.	Students might tell of various environmental warnings that have already occurred. The dangers of DDT to human life, for example, were revealed when the bald eagle and other birds began to die out because their eggs crumbled and could not hatch. DDT persisting in the environment was causing thin, brittle shells by interfering with calcium metabolism.
In discussing how the commons may be protected, pages 34–35, you might inform students that one Gallup public opinion survey found 73 percent of Americans willing to pay additional taxes	Some of the questions students could formulate for their poll are: Are you concerned about the environment? In what concrete ways are you willing to express your concern? What do you think

Suggested Teaching Strategies	**Possible Student Responses**
to improve their environment. They also proposed corrective measures which ranged from moving industry to the suburbs to prohibiting the use of pesticides. A student committee could make up its own questionnaire to poll class members about whether and how the commons should be protected.	is the most serious environmental problem? What national corrective or protective measures should be taken? Students might compare the results of their poll to those of the Gallup survey as reported in the magazine *Science and Children,* January–February 1972 (published by the National Science Teachers Association, Washington, D.C.).
When students probe Question 2 on textbook page 35, you might ask for volunteers to write science fiction stories about a future "paved-over world"—a world in which the entire earth has become an endless concrete city, and in which no untouched wilderness exists. What would be lost forever to us?	Students can create imaginative stories by extending to some extreme point a current environmental problem—as Rachel Carson did with pesticides in *Silent Spring.* In their stories, students might describe how humans adjust to a lack of contact with nature. They might imagine, for instance, many ameliorating technologies or perhaps "cells of nature" in which one can recapture the "good old days."
You can use the cartoon on page 36 to help students learn to interpret cartoons on editorial pages. Why does the cartoonist use humor to convey a serious message? Do you know of any situations similar to the one pictured, but not as harmless?	The editorial cartoonist uses humor to call our attention to serious social ills. Students should be able to think of a number of serious events analogous to the humorous situation pictured. A common one is that of a town dumping its sewage into a river regardless of the problems created for towns downstream, which use the same water.

NOTE: To help students analyze further the issues involved in use of the commons, they can be referred to magazine accounts like that of the California redwoods controversy in AMERICAN FORESTS, May 1971. The scope of activities of agencies protecting land use, such as the Bureau of Land Management (Department of the Interior, Washington, D.C. 20240) or the Forest Service (Department of Agriculture, Washington, D.C. 20250), can be gleaned from the most recent UNITED STATES GOVERNMENT MANUAL, the official handbook describing the purposes and programs of most federal agencies. The agencies could be contacted by a class representative for additional information about their activities and related legislation.

5 World Population Trends

Textbook pages 37–44

Developing Inquiry Skills

To recognize that a hypothesis is a tentative explanation that may be modified as additional data is gathered

To test a hypothesis by applying it to new data and determining whether the hypothesis continues to explain this new data

Developing Learning Skills

In independent reading, to distinguish between data and interpretations of the data

Knowledge Goals

To probe the view that industrialization may contribute to reducing population growth

To become alert to the consequences of continued exponential growth of world population

Clarifying Values

To consider whether, and to what extent, one should be concerned with the growth of world population

Developing a Positive Self-concept

To gain confidence in one's ability to evaluate authorities through examination of their evidence

Suggested Teaching Strategies	**Possible Student Responses**
You may wish to begin by checking students' understanding of the concepts developed on textbook pages 37–40. Question 1 on page 37 can be used for this purpose. You can then turn attention to the case study on pages 40–42. Students may be guided to separate the actual facts in this case study from the writers' analysis and conclusions, with questions like the following:	In responding to Question 1, students will interpret in their own words the feedback loops on textbook page 39.
These writers have collected evidence to help them explain a problem. What problem?	The writers are concerned with reducing population growth, which they hold partly responsible for various environmental disasters.
What is their hypothesis as to how exponential growth of population may be halted?	If a country industrializes, it will tend to reduce its birth rate.
What evidence do the writers present to support their hypothesis?	On page 42 they give statistics showing that several "industrialized" countries have lower birth rates than several "nonindustrialized" countries.
Help students recognize that this hypothesis—that industrialization is the factor explaining the difference between the two sets of countries—is an *inference* from the statistical data. Actually, what are the writers' *facts?* You might have these written on the board.	The writers' facts are: (a) The total world population has been growing exponentially; (b) The rates of growth are greater in some countries; (c) The rates of growth are lower in other countries.
Make clear that the lists of countries with high and low population growth rates are the *facts*. However,	The countries could, conceivably, be classified instead according to: temperate or hot climates; Eastern or

Suggested Teaching Strategies	Possible Student Responses
classifying these two sets of countries as *industrialized* versus *nonindustrialized*—and citing this difference as the sole cause of the different population growth rates—begins the interpretation of these facts. How else might the countries be classified? What other inferences could then be drawn as to the reasons for the different growth rates?	Western; ancient or relatively new nations. The countries might also be classified according to cultural, economic, religious, governmental, or even dietary differences. Each classification might possibly yield a different hypothesis to explain the pattern of population growth rates.
At this point students may conclude that the writers' hypothesis about population growth rate is only a tentative explanation for which more evidence needs to be gathered. How could you begin to test the writers' hypothesis?	Population growth rates in more countries would need to be collected to see if this pattern persists. Students could consult the table on textbook page 43, or annuals like *The World Almanac* or reports of the United Nations, The Population Council, or Zero Population Growth. Evidence can be presented to the class in bar charts or other graphic form.
Have the class examine the new evidence submitted. Does this evidence strengthen or weaken the hypothesis? Do students have alternative hypotheses to propose?	Students should recognize that in the social sciences, in contrast to the physical sciences, a hypothesis may be generally valid as a description of a trend. At the same time, the hypothesis may *not* apply to a few specific countries in which special factors modify this trend.
You might conclude by raising this question: If we accept the writers' hypothesis about world population growth, what can we learn from it to protect the world environment?	Discussion could center first on the consequences of continued exponential population growth. Then the role of industrialized countries in this problem could be discussed, as suggested in the values question on textbook page 43.

6 Industrial Production and the Environment

Textbook pages 45–51

Developing Inquiry Skills

To probe the interrelationship of elements within a system

To test the assumptions underlying a hypothesis

Developing Learning Skills

To construct a valid questionnaire for interviewing about attitudes

To interpret trends presented in diagrams and graphs

Knowledge Goals

To examine the effects of capital investment and economic growth on the environment

To understand how the economic aspirations of both the developed and developing countries affect the environment

Clarifying Values

To debate whether escalating rates of economic growth are the concern of all countries or only those directly involved

To question one's present consumption patterns and explain why these should continue or be changed in accord with environmental concerns

Developing a Positive Self-concept

To become more competent and willing to participate in a group discussion presenting a variety of views

Suggested Teaching Strategies	**Possible Student Responses**
A current issue among economists and others is: Will affluent nations have to curb their luxuries to conserve resources so that poorer nations can get resources to produce their necessities? The systems concepts on textbook pages 45–47 help prepare your students for this issue, which is the focus of the case study on pages 48–50. To review this preparatory material you can ask: What connection exists between capital investment and industrial production? What feedback loops show these connections? Why must a country invest in capital goods before it can produce consumer goods?	Students can find many newspapers and magazine stories that reflect the concepts developed here. Volunteers might preview this material and bring in representative clippings to stimulate interest. Newspaper reports of economic growth—such as "Ghana Moves to Stay No. 1 in Cocoa While Striving to Diversify" or "Mills Need Equipment, Financing Tough"—may be displayed for discussion.
Students can then examine the current implications of this material by responding to Questions 2 and 3 on page 45 and the values-clarification questions in the case study on pages 48–50. You might also separate the class into committees, each to consider one of the questions below, which tackle the case study problem from different angles.	Students should try to probe and explain the reasons for each position they take. They may find that they need to modify their views as they exchange opinions with those of different views.
Has the past pattern of industrial development been the same in all countries? What might be some of the reasons for differences?	Lack of industrial development in some countries might have been caused by such factors as: geography, as in the lack of natural resources or access to trade routes; traditional patterns of land ownership, as in a feudal economy; growth restrictions arising from a country's colonial relationship to an industrialized nation.

Suggested Teaching Strategies	Possible Student Responses
Can world capital investment continue to grow? Questions like these can encourage debate: Are the crises described in the case study inevitable? Can these crises be avoided even if industrial production keeps on growing? If so, how?	Students may offer a number of alternatives to the negative viewpoint developed in the case study. As they do so, they should try to provide supporting evidence and reasoning for their position.
If you had capital to invest, would you invest it in industry? Where else could you invest it? What might be the reasons for your choice of these alternatives?	Capital could, instead, be invested in agriculture or the production of services, such as health care or education. The latter is comparatively nonpolluting and less wasteful of resources and conceivably agriculture could also be made so. Of course, certain capital goods (such as tractors for farms) are needed for these alternatives, and therefore some investment in industry must go on as well.
What are some of the factors that may block industrialization in the developing countries?	Problems other than those cited in the case study include: Some countries cannot divert capital from agriculture to industry because food production is still inadequate. Moreover, they may not have the capital to divert. Or their position in world trade may require that they remain "one-crop economies," producing, for example, coffee or sugar for export rather than industrial products for use at home.
A summing-up question could be: Why don't the developing countries overcome their poverty and population problems by just increasing their capital investment in industry? Students can recognize that this question is based on the assumption developed in a previous case study (textbook pages 40–42), namely that if industrialization increases, the rate of growth of population decreases.	Applying the new learnings, the class might now speculate as to where the capital for industrialization would come from; whether the resources and skilled labor would be available; how pollution problems would be handled.
Students who do the second activity on textbook page 51 might be interested in a Harris Survey reported in newspapers of about December 3–6, 1975. A majority of Americans agreed to such cutbacks as: having a meatless day a week; halting annual fashion changes in clothes and autos; cutting down on household conveniences of paper and plastics.	Questions should be framed to avoid predisposing interviewees to the "right" answers. Questions should also include ways of checking that people really "feel that way." For example, those willing to use fewer paper products might be asked to imagine themselves as workers in that industry. Would they also be willing to take the salary cutbacks from a reduced demand for paper products?

7 A Pollution Crisis

Textbook pages 52–59

Developing Inquiry Skills

To define the environmental problem by analyzing the evidence in a case study

To hypothesize about the causes of the problem

To develop and evaluate alternative solutions to the problem

Developing Learning Skills

To listen critically to conflicting viewpoints, discerning bias from fact

To read a case study for main ideas, identifying those aspects of the case study that have broad application

To locate sites on a map

Knowledge Goals

To identify some of the issues involved in controlling industrial effluents

To understand the work of regulatory government agencies in protecting our water supplies

Clarifying Values

To state the issues in an environmental controversy and take and defend a position

To determine one's own role in promoting government and industry action to protect the environment

Developing a Positive Self-concept

To feel able to collaborate with others in clarifying environmental issues

Suggested Teaching Strategies	**Possible Student Responses**
The case study "The Mississippi Fish Kill" focuses on pollution problems created by capital investment in unregulated industries. To prepare your students to take their part as informed citizens supporting appropriate legislation, it is important for students to avoid a "good guys and bad guys" approach to case studies of this type. You can, instead, help your students examine objectively the many regulatory problems involved. Toward this end, you may want to raise the following questions for discussion:	The student responses that follow may be elicited in small group or class discussions or prepared individually in advance of the lesson.
Suppose you were the manager of this factory—or of any manufacturing plant. Why would you want to use a local sewer or river for discharging the plant's wastes?	It is costly to build special waste outlets or treat the wastes to make them harmless. The company may fear competition if it raises its price to cover the cost of pollution controls.

Suggested Teaching Strategies	Possible Student Responses
Apart from economy, what other reasons may the company officials offer for discharging the wastes in this way?	Students can develop many reasons for the company's position by probing into the case study: (a) It has always been done this way; rivers and lakes have been used as dumps for centuries; (b) We were not aware that the practice was harmful. What scientific proof do you have that it is? (c) We follow government regulations. If these are out-of-date and inadequate, it's not our fault; (d) We would like to use pollution control devices, but they don't exist for our industry. Who's going to develop them? (e) We may need to go out of business if we have to develop and install pollution-control devices. Then jobs as well as profits will be lost.
What are some possible answers to the company's arguments?	As students develop counterarguments to the company's position, they will probably invoke values questions like those on textbook pages 55 and 57. Students will, for example, need to take a position on: who is to bear the cost of pollution-control devices; who should be liable for damages from pollution; what laws should be supported to prevent or discourage pollution; whether they will be willing to pay more for products so that manufacturing processes can be modified to protect the environment.
One counterargument that students may not think of is suggested by the following statement made by some environmentalists: "There is really no such thing as pollution. There is only matter in the wrong place." You might write the statement on the board and ask students to interpret it.	Interpretations of the saying can lead students to recognize that industries may need to try harder to convert wastes into byproducts. Formerly undertaken primarily to increase profits, research into byproducts has become a critical aspect of environmental protection today, along with salvage and recycling operations.
The above points could be developed by dividing the class into four committees, each representing the viewpoint of one of the following groups: managers of the chemical plant; residents in downriver communities; local farmers; the federal government. Each group should prepare to answer the following questions: Should this chemical plant and similar plants along the Mississippi River be shut down? Why, or why not?	Students should be able to represent the viewpoint of each group by using information in the case study. Main arguments could be written on the board, so that they can be answered by the other groups.

Suggested Teaching Strategies

Besides pesticides, discussed in the case study, metallic byproducts of industry are also polluting the environment. When the mercury diagram on page 59 is analyzed, students selected in advance could report on the causes and dangers of the increase of mercury compounds in the environment. To prepare their reports, they might consult such sources as *Water Pollution* by McCaull and Crossland (Harcourt Brace Jovanovich, 1974) or the magazines *Environment,* January–February 1972 and *Scientific American,* May 1971.

Students might also be asked to look ahead at textbook page 83 of a later case study to acquaint themselves with the kinds of environmental disasters that revealed the danger of methyl mercury in particular. Methyl mercury becomes concentrated in fish by the same process that pesticides become concentrated in the aquatic food chain described on textbook page 87.

Possible Student Responses

From the diagram, students can infer that mercury from the air, soil, or water can accumulate in the food chains and be transferred to humans in food and drink. Industry sources of environmental mercury that students might report on include: electrical equipment such as alkaline batteries, which contain about 8 percent mercury; paper and plastics whose manufacture requires mercury. When these items are burned in incinerators, gaseous mercury is given off into the air, washed by rain into oceans and rivers, and there converted by bacterial action into toxic compounds of mercury, in particular methyl mercury.

8 Values and Pollution Problems

Textbook pages 60–69

Developing Inquiry Skills

To hypothesize that people perceive environmental issues from different frames of reference and value systems

To use a decision-making model to identify the problem-solving steps needed for informed citizen action

Developing Learning Skills

To glean details from a case study to express a particular point of view in role playing

Knowledge Goals

To weigh the possible benefits and risks to the environment of a nuclear power station

To examine some of the methods used by citizens to influence the outcome of environmental issues

Clarifying Values

To consider the extent of environmental damage one is willing to accept to obtain needed electric power

Developing a Positive Self-concept

To be sufficiently confident to confront opposing viewpoints in role playing

Suggested Teaching Strategies	Possible Student Responses
This case study stresses the opposing viewpoints that often arise toward environmental problems. Such case studies lend themselves well to role playing, with the class divided into groups expressing the different points of view. Students can be asked to examine the case study in advance to decide which community group they wish to represent in a meeting on the issue: Should this nuclear power plant be built? You will want to make clear that role playing does not require set speeches memorized in advance as dramatization does. Students will need simply to gather as much information as possible to "get into" the feelings and thoughts of the people they represent. After the role playing, the following questions may help students gain further insight into the way complex environmental issues may be resolved:	In preparing for their roles, students should analyze the case study to determine: the factual basis for their position; the values basis; how they feel about the positions taken by the other groups; how they might convince those groups of the rightness of their own position. Students will need to keep in mind that the issue is whether this particular plant, rather than nuclear plants in general, should be built under the given circumstances. (Students might be informed that Cayuga Lake is a "slow-flushing" lake; it takes about nine years or more for a drop of water to move all the way through the lake. Because of this slow movement, even low levels of contamination from the plant—whether thermal or radioactive—would tend to build up and become concentrated at high levels.)
What brought the members of each group together? How did each group reach a concensus among its members?	Students can show that similar backgrounds, values and/or economic interests tended to determine the composition of each group and its attitude toward the nuclear plant.
To what extent did each group seek information and evidence upon which to base its attitude toward the plant? How could this information be obtained and how complete was the information available?	The case study reveals that the community obtained its information both from the company and from the university scientists. Students can surmise that the company hired its own specialists to develop information. Most importantly, students begin to recognize that often environmental decisions have to be made in the absence of adequate information. Indeed, getting information may be the most difficult part of the decision-making process.
Was there any formal or standard community procedure to resolve the differences among the groups? If not, what recourse did each group have? Do students see ways of improving this process?	Students recognize that although there was no fixed procedure, there were avenues provided by the democratic political process. Moreover, since power companies are public utilities, they have to be granted state and federal permits

Suggested Teaching Strategies	Possible Student Responses
	for their operation. Thus, the citizens' groups tried to gain support from the public and from legislators to delay the permit until an effective cooling system was designed. Some of the methods they used to gain support are described on page 65 of the textbook. Students might also propose other possible methods.
Could there have been a simple solution to the conflict described in this case study? You might ask students to select and defend in writing the solution most likely to protect the quality of life in the communities around Cayuga Lake. Students could be advised to use the decision-making model in Question 1 on textbook page 68 to guide the construction of the solution.	To the citizens' committee, redesigning the cooling system seemed a simple solution. However, the power company chose, instead, to scrap its plans in favor of building a conventional coal-burning plant. This plant will undoubtedly present pollution problems of its own. Thus, although the dispute is "settled," the larger problem that prompted the dispute remains: how to provide additional electric power without harming the environment.
To conclude, you might have students review the opposing attitudes that needed reconciling to reach a genuine solution to the problem.	Some company attitudes that students might cite are: The power plant has to be built now, and as economically as possible; the electric power is critically needed and its benefits will far outweigh its risks; moreover, the risks are not proven, but are only paper speculations. Community attitudes included: The environmental problems created will be greater than the benefits; the benefits can be obtained by other, less risky means; since the risks are so difficult to assess, why take these risks?

9 Our Nonrenewable Resources

Textbook pages 70–79

Developing Inquiry Skills

To probe the validity of forecasts of dwindling resources by examining the underlying assumptions

To identify evidence that supports or weaken the forecasts

Developing Learning Skills

To interpret data presented in tables

To gather additional data on an issue

Knowledge Goals

To explain why conservation of resources is essential to both developed and developing nations

To describe a range of proposals for preventing resource depletion

Clarifying Values

To take and defend a position on a strategy for resource conservation

Developing a Positive Self-concept

To develop the habit of using newspapers and other media in a continuing process of self-education

Suggested Teaching Strategies	**Possible Student Responses**
A week or two before classwork on this case study, students can begin to collect newspaper and magazine articles about the resource problems discussed in the case study. Information in the articles can be brought to bear upon the opening questions on textbook page 70 and the activities on pages 78–79. The following discussion can serve to consolidate understandings gained from the case study:	Almost daily, students will find articles on resource problems. The articles may tell, for instance, of: a rise in the price of a particular resource; conflicting estimates of the scarcity of a certain resource; a substitute developed for a scarce resource; new recycling technologies; discovery of new deposits. Students should decide whether the information in each article seems to support or conflict with statements in the case study.
Why are nonrenewable resources of such concern today? Do you think the concern is justified? Why, or why not?	The supplies of nonrenewable resources are fixed, but the needs for them are increasing to produce the items deemed necessary for life today. In the developed nations, the exponential increase in industrial production places a heavy demand on these resources. At the same time, the economic and political aspirations of the developing nations are requiring them to put greater and greater claims on these resources.
How may dwindling resources affect the developing nations?	Students should be able to draw on some of the evidence and postulates in earlier case studies, such as "Can the Developing Nations Industrialize?" on pages 48–50.
What are some proposals for meeting the resource shortage?	Proposals range from the technological, such as recycling, to changes in values, such as less dependence on consumer luxuries. Students should analyze the strengths and weaknesses of each proposal presented.
Should affluent nations like the United States concern themselves with the needs of less affluent nations for	Confronted with a wide range of opinions on this issue, students can begin to clarify their attitudes toward our

Suggested Teaching Strategies	Possible Student Responses
resources? Why? If your answer is yes, how may that concern be expressed? What steps should be taken? By whom? To conclude this discussion, you might have students bring in their written responses to the questions under "To Consider and Discuss" on textbook page 78, which approach the same problem indirectly.	country's relationship with developing nations. They can also show their awareness of how this relationship will affect the world environment.

10 The Quality of Water

Textbook pages 80–89

Developing Inquiry Skills

To examine evidence of water pollution

To hypothesize about the trends responsible for water pollution

Developing Learning Skills

To classify details in a case study

Knowledge Goals

To identify major threats to the quality of water and the agents creating these threats

Clarifying Values

To choose those actions that one feels would be most useful in protecting water resources

Developing a Positive Self-concept

To feel able to take a useful role in protecting water resources

Suggested Teaching Strategies	Possible Student Responses
In this case study, students probe many of the ways in which water is being polluted today. You may want to use the two questions on textbook page 80 to review understanding of this material. Perhaps you can arrange in advance for volunteers to report in detail on some of the more complex threats mentioned in the case study—such as eutrophication, the mercury contamination represented by the Minnemata disaster, or the environmental impact of dams.	Students who do the additional research might present some of their findings in graphic form to be displayed for examination by the class. They should cite the sources of their information. A variety of references, including *Water Pollution* by McCaull and Crossland (Harcourt Brace Jovanovich, 1974), may be consulted by able readers.
In earlier case studies, students examined the exponential growth of various environmental factors: capital	This discussion can help students gain a broader view of the water pollution problem as not merely an

Suggested Teaching Strategies	Possible Student Responses
investment in industrial production; capital investment in agriculture; growth of population; use of resources. You might write these on the board and ask which types of growth seem to be fostering water pollution. How?	accident of our time, but a direct result of current trends. The various kinds of pollution described in the case study could now be classified as stemming from industrial production, agricultural production, and so on.
Students could now be asked to consider which threats to water can be prevented, which cannot. You might have each student choose one threat, and write a brief statement about what actions may be taken to prevent it. If time permits, enough statements can be read to the class to reveal a broad range of possible actions.	Students might, for instance, suggest such actions as writing to legislators about a projected dam, or deciding not to buy the products of a polluting industry. The class can debate the value of the specific actions suggested. They might also propose broader social, economic, or legislative programs to reduce contamination of the water supply.
You may also want to select in advance of the lesson a class committee to determine from newspaper accounts or local agencies the possible sources of water pollution in your area. Do these affect recreational waters? commercial fishing? industry's need for water? household water? community health in general? The committee may also be asked to find out what safeguards already exist for protecting the local water supply.	Local safeguards that students might note are the methods used to make the community drinking water safe, legal controls of bathing and fishing areas, penalties for contamination, and imposition of such penalties reported in newspapers.

11 The Hungry World

Textbook pages 91–97

Developing Inquiry Skills

To test assumptions underlying a hypothesis about food shortages

Developing Learning Skills

To apply information gained through additional independent study

To interpret a map in terms of the unique scale set up for that map

Knowledge Goals

To describe world food shortages in terms of both quantity and quality of food

To identify protein as the prime nutrient in short supply

To recognize that increases in population may outstrip increases in food production

Clarifying Values

To begin to explore one's possible role, as a member of an affluent nation, in alleviating world hunger

Developing a Positive Self-concept

To enlarge one's sense of responsibility to include global concerns as well as personal concerns

Suggested Teaching Strategies	**Possible Student Responses**
That some nations lack food and that land is needed to produce food may seem to your students too self-evident to provoke much thought. In advance of the lesson, therefore, you might select students to probe more deeply into some of the statements in the case study, so that they can bring supporting or conflicting details to the class discussion. Following are a few of the statements that might be explored in this way:	Students might do their additional research either individually or in groups, focusing on the underlying data required to substantiate the generalizations.
". . . perhaps one third of the world population is suffering from malnutrition if not downright hunger and starvation" (textbook page 93). What actual numbers does this percentage represent? Where do most of these people live? What might be some of the reasons for food shortages in these countries?	Students can consult annuals like *The World Almanac* for current population statistics. These statistics will clarify the disproportionate sizes of certain countries on the unusual "hunger map" on page 92. Students might begin hypothesizing about the reasons for food shortages in those countries, seeing possible links in their geography, history, extent of economic development, or other conditions.
"At least 60 percent are not getting the minimum quality of food need to maintain health" (textbook page 93). Perhaps begin a discussion of this point by writing the following headings in three columns on the board: energy; growth and repair of body tissues; regulation of body processes. You can call on students to write under each heading one food they have had in the past day that served that purpose primarily.	Students will probably know that foods high in starches and sugars are most valuable for energy; nitrogen-containing, or protein, foods, such as fish, meat, and eggs, are needed chiefly for growth and repair; fruits, vegetables, and whole grains yield energy and also—as do other foods—the vitamins and minerals that regulate body processes.
Then ask students to refer to the map on page 92 to name some of the countries having below-adequate calorie intake. Circling the "growth and repair" list of foods on the board, you can now ask: Which of the foods listed here are eaten regularly in those countries? What are the main foods of the diets of those countries?	The differences between the diets of affluent and poor countries should show up most clearly in the protein foods. About 70 to 80 percent of the diet of such countries as India, Mexico, Japan, and China consists of plant foods such as rice, corn, or wheat, instead of the animal proteins that are staples in this country.
"People in the poorer countries eat little meat, milk, fish, or eggs" (textbook	The body requires more than twenty-two amino acids to build body

Suggested Teaching Strategies	**Possible Student Responses**
page 93). The advantage of animal proteins over plant proteins may need to be clarified, perhaps by a student report. There are many misconceptions about this problem. Students could be referred to such books as *Diet for a Small Planet* by Frances Moore Lappé (Ballantine Books, 1975), or *Population/Resources/Environment* by Paul R. Ehrlich and Anne H. Ehrlich (W. H. Freeman, 1972). They may also use *The Reader's Guide to Periodical Literature* to find articles such as "The World Food Crisis" in *Time* magazine, November 11, 1974.	tissue. Eight of the amino acids are called "essential amino acids" because they cannot be manufactured in the body but must be taken in from food. Moreover, they must be eaten in the right proportions and at the same meal if they are to be used effectively by the body. Most plant proteins, such as peanuts, lack one or several of the amino acids. Therefore, several different kinds need to be eaten together to complement one another. The diets of many poor countries are deficient in proteins not only because of the low total amount taken in but also because their plant proteins do not yield the complete spectrum of amino acids.
Pages 93–96 of the case study develop the hypothesis that world food shortages arise chiefly from the combination of dwindling farmland and growing populations. Perhaps make clear that this hypothesis has been faulted as Malthusian (textbook page 96) because it stresses the earth's physical limits and overlooks human ingenuity in coping with those limits. Perhaps raise for discussion: What is the supporting evidence offered in the case study? To what extent do you agree with the hypothesis? How would you modify it? Do you have alternative hypotheses to propose? This discussion can lead to the next case study, pages 99–105.	Students might raise the following kinds of arguments: How can we talk about running out of new farmland when we are not using our present farmlands as productively as possible? Why do we grow so much coffee, tea, and tobacco when we could be growing grains instead? Why do we feed so much grain to cattle instead of people? If overpopulation is the problem, why aren't densely populated countries like Belgium and Japan the hungriest? Student responses can reveal how complex the food problem is and that focusing on a single root cause is probably not helpful in seeking solutions to food shortages.

12 Food For The Future

Textbook pages 98–106

Developing Inquiry Skills

To gather evidence on the effectiveness of plans for increasing food production

To evaluate the plans on the basis of the available evidence

Developing Learning Skills

To screen magazines, books, and newspapers for additional data about each plan.

Knowledge Goals

To describe a variety of plans for alleviating world food scarcity, including their environmental advantages and hazards

Clarifying Values

To consider one's role in affecting the global problem of hunger

Developing a Positive Self-concept

To feel able to support one's convictions with valid evidence

Suggested Teaching Strategies

In advance of the lesson, students could be asked to find out more about the plans for increasing food production described in the case study. As each plan is discussed, you can encourage recognition that there is no single best solution but that a variety of efforts may be needed. This statement by Lester R. Brown, the agricultural expert, may be written on the board to help point up one of the dilemmas: "The central question is no longer can we produce enough food, but what are the environmental costs of doing so?"

Following are some of the pros and cons that students can bring from independent research to the discussion of each proposal.

NEW FARMLANDS

Pro: Many potentially arable lands—for example, in the tropics—which get plenty of rainwater for crops, remain unfarmed. According to Roger Revelle, arable lands not yet being farmed could support over 30 billion people.

BETTER YIELDS

Pro: The Green Revolution permits us to get greater yields from present farmlands by breeding food plants with superior nutritional and growing traits. For example, in an experiment in Peru, a potato has now been grown in 31 days in a warm, humid region—just a fraction of the normal growing time needed in cooler climates. Such a potato could become a backyard crop in impoverished South American countries. It could even be planted in rice paddies in between the planting of rice crops. (Reported in *The New York Times,* August 5, 1975.)

Possible Student Responses

In evaluating each plan, students can use evidence from the case study, as well as evidence gained from additional research on their own, to discuss how realistic each plan is in terms of money, time, and cooperation required to carry it out; what might be some of the environmental effects of each plan.

Con: It's not easy to convert land into farmland. Ecological balances can be disturbed by agriculture just as by an oil pipeline. As an example, rain forests depend on a natural "cover" of foliage from trees. When land is cleared for farming, this cover is removed and rains fall unchecked. Rich soil is washed away and soil minerals leached out.

Con: The so-called miracle grains depend on capital investment in fertilizers, pesticides, and irrigation. Poorer countries need to depend more on cheaper, time-proven methods consistent with their ecology, such as the intercropping system of Japanese farmers. They plant a low-stature crop (soybeans or rice) along with a taller crop (corn). Intercropping patterns protect against weeds and pests and yield 30 to 60 percent greater crops than single-crop planting.

Moreover, the Green Revolution is only a grain revolution—raising the output of the cereal grains wheat, corn, and rice. These do not alleviate protein shortages

Suggested Teaching Strategies	Possible Student Responses
	(see textbook page 93). The especially important "pulses," such as beans, peas, and lentils, which are the chief plant sources of quality proteins, remain low-yield crops.
NEW FOODS *Pro:* Major oil companies (such as Standard Oil and British Petroleum) have set up multimillion-dollar factories to get "food from oil." A variety of yeasts, molds, and bacteria are bred on selected oil products. Similar processes are being developed to breed these single-cell proteins also on sewage sludge and waste paper. These amazing feats, if they become practical, could help to solve our food problems by making food production, for the first time, independent of the vagaries of land and weather.	*Con:* These foods have yet to be made palatable for human use. Moreover, the complex technology for producing these foods makes them much too expensive for the very countries that they are intended to feed. A case in point is the soybean, ordinarily fed to animals. Now that soybean products have been developed that are acceptable to human taste, these products are appearing in the food markets of affluent countries, not poor countries.
FARMING THE SEAS *Pro:* Food production depends on solar energy, and oceans get twice as much solar energy as land. To increase ocean food production, let's bring nutrients from the ocean bottom to the surface by stimulating vertical ocean currents (upwelling). (See "Marine Farming," *Scientific American,* December 1970.) We can even put a floating fertilizer into open seas. Since ancient times, the Far East has "farmed" oysters by collecting their spawn and seeding breeding areas. The areas are cleared of enemies so that the eggs can develop. Free-swimming fish could also be "farmed" by raising fry in protected ponds and then returning them to the sea in nets.	*Con:* Most of the sea cannot provide food. Marine life depends on plant life. The plant life, in turn, must remain on the ocean surface to get sunlight. Moreover, the plants must also grow in areas where there is an upwelling from deep waters, since they depend on nitrogen and nutrients from dead organisms that have fallen to the bottom. Because of these problems the open sea is relatively infertile. In fact, 90 percent of the surface of the sea gives us only about 1 percent of our catch. As to the farming of free-swimming fish: This is much more difficult and costly than farming such animals as oysters, which remain fixed to an area.
EATING LESS, WASTING LESS *Pro:* Cattle convert grasses not eaten by humans into quality proteins such as meat and milk. But today cattle are being fed costly grains that people could eat. Over 60 percent of our grain output is now fed to livestock and poultry. We should be eating the grains. According to Lester Brown, each of the two billion people in the poorer countries takes in about 360 pounds of grain a year. The average American takes in more than 1600 pounds of grain a year, even though only about	*Con:* Returning some of our farmlands to grazing land would be inefficient use of land. "The amount of grain raised on 1 acre of farmland will feed six to eight times as many cattle as would 1 acre of grass in most places in the United States." (Horst Kehl, in *Science,* January 31, 1975.) Moreover, if people in affluent countries increase their demands for cereal grains, soybeans, and other plant foods, this would only increase the cost of these grains to the poorer countries.

Suggested Teaching Strategies	Possible Student Responses
150 pounds is eaten directly in cereal and breads. The rest goes to feed the livestock and poultry that provide meat, milk, and eggs.	
To sum up, you might ask what connection exists between food production problems and the other world environmental factors that have been studied. This discussion can help students recognize that food shortages require for their solution a multi-faceted global attack on environmental problems in general.	Students may cite as contributing to food production problems: the dwindling of resources such as oil, land, fresh water; the growth of population, which not only requires more food but further encroaches on the land and other resources needed to produce the food; the growth of pollution, which still further reduces usable resources; the growth of industrial production, which diverts resources from food production to the production of other goods.

13 One Look at the Future

Textbook pages 107–17

Developing Inquiry Skills

To test assumptions underlying a model of the global environment

To hypothesize about the interrelationships of major world environmental factors as projected by the model

Developing Learning Skills

To interpret environmental trends from graphed data

Knowledge Goals

To generalize about possible long-term changes in the environment from projections of current trends

To examine conflicting opinions about the methods used and the conclusions drawn from the projections

Clarifying Values

To evaluate one's economic and social choices in terms of their effects upon the environment

Developing a Positive Self-concept

To develop confidence in one's ability to use evidence and reason in assessing the positions of authorities

Suggested Teaching Strategies	Possible Student Responses
The graphs in this case study show various forecasts made with the use of a computer. The forecasts are based on	Students can point out that all the graphs show the so-called "growth-and-collapse" curve. In the first model, the

Suggested Teaching Strategies	Possible Student Responses
interactions of the five major environmental factors that students explored in earlier case studies. You might divide the class into four groups and assign one computer run to each group for a ten-minute analysis. The following questions, written on the board, could guide each group's work and its summary report to the class: What are the environmental factors whose trends are plotted on this graph? Does this computer run assume control of any of these factors? If so, what are these controls? Given the assumed controls, what is the forecast about the future world environment?	standard world model (textbook page 110), all factors are growing exponentially by 1970 except resources, which are already dwindling. In time, resources become so low that industrial production starts to fall. Then food production, which depends on resources and industry (land, nonpolluted fresh water, pesticides, fertilizer, energy) declines. After a natural lag, the population begins to die out from lack of food. In this model, then, the resource crisis is the cause of eventual collapse. In the subsequent world models, various social and technological policies simply postpone the problem. Moreover, by making it possible for industry and population to grow to even more extreme heights, the growth curve is magnified and the collapse even greater when it finally does come.
After the reports, you may wish to introduce the terms "prophets of doom" and "growthmania," asking students to speculate about what the terms represent. Inform students that these labels have been used for opposing sides in the controversy aroused by the computer study. Encourage students to try to explain the aptness of the labels for different viewpoints toward the study. (See NOTE on next page.)	Students can speculate that the computer forecasters are called the prophets of doom because all their world models predict an environmental catastrophe; even major scientific achievements, such as controlling pollution or preventing the depletion of resources, serve only to postpone the catastrophe, not to eliminate it. In turn, the forecasters say their critics are addicted to "growthmania." The forecasters stress that the earth is finite, its resources and capacity to support life are limited, and, therefore, population and production of goods must also be limited. Their study reveals, they claim, that environmental catastrophe is inevitable if current exponential growth continues. The continued growth of capital investment and, with it, industrial production and population could result in severe pollution and depletion of food and other resources within a century.
Would it be wise for public policies to be based on computer forecasts such as these? This question can spark discussion of the possibility of looking into the future and shaping it. Do you believe these forecasts of growth and collapse? Is it possible to develop a model of such a complex system as the	Students will voice their opinions more readily if they learn that authorities hold comparable opinions. Toward this end, student opinions that you *cannot* project a present trend into the future could be related to a comment by Herman Kahn (of Rand "think tank" fame): If you used the growth rate of a

Suggested Teaching Strategies	Possible Student Responses
world environment and get valid forecasts? During the above discussion you may wish to call attention to the cartoon on textbook page 117, inspired by a second computer study of the future world environment. What aspect of computer studies is the cartoonist taking a jibe at? The cartoonist is obviously questioning the validity of computer studies by revealing that the second contradicts the findings of the first.	17-year-old to find out how big he would eventually be, you would predict that he'd be a monster by 25! Student opinions in favor of modeling by computer could be related to Jay Forrester's comment that understanding a complex phenomena like the world environment is much too difficult for ordinary human thought processes and therefore computer analysis is our only hope. Even though the model has shortcomings, states Forrester, it gives us the chance to test the interactions and outcomes resulting from specific policies. Other student opinions can probably be related to various opinions of experts cited on textbook pages 114–16.
You might conclude by having the class consider: Regardless of your point of view toward the conclusions of the computer study, has this study served any useful purpose? Have these forecasts made you more aware, for instance, of certain world problems? Do you perhaps see more clearly some current trends that should be curtailed? You might also inform students that they will be examining three possible "solutions" (pages 122–47) to avert the crises predicted. Students who do the "Individual/Small Group Activity" on textbook pages 116–17 might present their work later, when the "technological solution" is examined.	Some students might generalize, giving examples from the graphs, that the computer study helped them become more aware that: all environmental factors are interdependent; a change in one factor "feeds back" to change another factor (see earlier discussions of feedback, on textbook pages 37–40 and 45–47); positive short-run outcomes can have negative long-run consequences. The computer study may also be helpful in raising questions about whether, where, and how brakes to growth should be applied and whether our life style needs to be modified to protect our environment and ourselves.

NOTE: Accounts of the controversy surrounding this computer study, readable by your students, appear in the UNESCO COURIER, January 1973 ("The Limits to Growth" and "Limits to the Limits to Growth") and BUSINESS WEEK, May 12, 1975 ("Meadows: Curbing Growth"). Some of the pro-growth arguments opposed to the study's arguments, are summed up in READER'S DIGEST, March 1972 ("How Best to Protect the Environment").

UNIT 3 THE CHOICES AHEAD

14 Signs of Stress

Textbook pages 119–21

Developing Inquiry Skills

To infer environmental problems from photographic evidence

To formulate hypotheses relating these problems to the exponential growth (or decline) of various environmental factors

Developing Learning Skills

To translate visual evidence into verbal form

Knowledge Goals

To describe the environmental impact of various forms of exponential growth

To relate world trends to local environmental problems

Clarifying Values

To consider the extent of individual involvement necessary to reverse harmful environmental trends

Developing a Positive Self-concept

To have the confidence to share one's values with others

Suggested Teaching Strategies	**Possible Student Responses**
You might begin by pointing out that there are several steps in the process of "reading" photographic evidence. The first step is to describe, as literally as possible, what one sees taking place. This step could serve as the response to introductory Question 1, on textbook page 119. The second step is to interpret what one sees, to draw inferences therefrom. This would be the response to Question 2 on page 119.	In three of the photographs, students see: a traffic jam; a crowded housing development; huge skyscrapers surrounded by smog (in Sidney, Australia). Students will probably interpret these scenes as typical of highly industrialized countries. However, some students may recognize that today such scenes are also representative of major large cities of some of the developing countries. The remaining two photographs show scenes that may be interpreted as typical of many impoverished, nonindustrialized countries. Primitive plowing is interpreted as subsistence farming. A group of children with food bowls is interpreted as hungry children waiting for a food distribution. Students deduce the factors responsible for these stressful situations. For example, the auto traffic jam is inferred as arising from a combination of exponential industrial and population growth.
The third step, called for in Question 3 on page 119, is essentially a values decision. Students can recognize that any estimate of how quality of life is affected is based upon underlying values as to what constitutes a good or bad quality of life. Students should be	As an example: the traffic jam suggests a world with: exponential increase in air pollution; exponential decrease in the resources needed to manufacture the automobile; the loss of esthetic, quiet, natural areas to highways; greater opportunities for

Suggested Teaching Strategies	Possible Student Responses
encouraged to delineate both the negative and positive aspects of each scene before trying to make a final evaluation of its general effect upon the quality of life.	vacation travel; greater facilities for the sharing of the resources of different communities; more mobility in seeking employment and places to live.
The fourth step, called for in Question 4 on page 119, is to relate what one has described to one's own life. If students do not see a direct connection between a particular scene and their own environment, encourage them to infer indirect connections.	Students speculate about how their own environment will be affected sooner or later by this problem in a distant environment. They may also consider how their own way of life, if continued, will affect the problems in those environments.

15 Industrial Growth—A Solution?

Textbook pages 122–29

Developing Inquiry Skills

From the evidence in a case study, to draw inferences about the effect of industrial growth on village life

To classify changing economic conditions according to their positive and negative impact upon quality of life

To extrapolate the consequences of continued industrial growth

Developing Learning Skills

To gather knowledge about another society to understand that society's frame of reference for value decisions

Knowledge Goals

To analyze how industrialization has affected an agrarian society

To compare conflicting viewpoints toward the environmental changes wrought by industrialization

Clarifying Values

To rank items according to their importance in a life of good quality

To determine the extent of one's dependence on industry to achieve that quality of life

Developing a Positive Self-concept

To begin to develop empathy with people of other cultures in evaluating the effects of social change upon them

Suggested Teaching Strategies	Possible Student Responses
After students rank the items listed in the first case study, on textbook page	A common concept of industrial growth is that it provides desired

Suggested Teaching Strategies	Possible Student Responses
123, they might use their lists to write a brief report generalizing about the extent to which they depend upon industry for a good quality of life. If these reports are written prior to the lesson, a representative variety could be read aloud in class. A list of the gains and losses students perceive from industrial growth can be developed on the board as the reports are discussed. Throughout, you can encourage debate over asserted gains and losses.	consumer goods, such as TV sets and automobiles, but also brings environmental hazards, such as pollution. Some students may view industrial growth as making it possible for the average person to enjoy features of the "good life" once available only to the privileged. The automobile, for instance, while creating environmental problems has provided a new mobility in seeking work, a place to live, and the opportunity to travel.
As students turn to the second case study, on pages 123–29, you might raise the question: How has increased industrialization affected the quality of life in Namhalli? Students should recognize that a different frame of reference is now required—that of the villagers themselves. To help students develop this frame of reference, have them recall what life was like in Namhalli before industrial growth. Suppose the villagers had drawn up a list like the one on page 123 of the textbook. What would *they* have ranked as *their* major needs and wants at that time? In general, how would their list have differed from the ones students made up for themselves? Which of the villagers' needs and wants were satisfied before industrial growth? after industrial growth? Did their needs and wants change with the onset of industrial growth? If so, how? What are the chances of these new needs and wants being satisfied as industrial growth continues?	After developing the rank-order list from the viewpoint of the villagers, students can generalize about the major ways in which industrial growth has improved or degraded Indian village life. Students can use evidence from the case study to support their opinions. They can be encouraged to distinguish between their own opinions of the losses and gains and the opinions of the villagers. The following kinds of changes, presented in the case study, can be evaluated: changes in diet; greater educational facilities; better medical care; salaried jobs in business and industry instead of farm jobs; machine-made clothing; more elaborate homes; noise pollution; loss of scenic areas; routinized assembly-line jobs; pesticide pollution; fewer avenues of artistic expression. Students can also examine the effects of industrial growth on Namhalli population size, use of land, personal freedom, income, family life, and village unity.
How may continued capital investment in industry affect the future quality of life in Namhalli? Why?	In responding, students may tend to raise for debate these kinds of questions: Must traditional life disappear, or can both old and new ways survive side by side? Are the costs of industrial growth inevitable? Must Namhalli repeat the problems that accompanied industrial growth in the nineteenth and twentieth centuries?
Should developing nations try to increase their capital investment in industry in order to "catch up" with the developed nations? Why? The different significance of industrial growth for rich and poor countries will	Students consider such problems as: what "catching up" means; whether it means just providing basic needs or also satisfying new demands for luxuries. Students might also review some of the problems facing the people of Namhalli

Suggested Teaching Strategies	Possible Student Responses
become evident here and in the later case study "An Equilibrium Society," on textbook pages 142–46.	before industrial growth and speculate as to whether these problems could have been solved without industrial growth.

16 Technology—A Solution?

Textbook pages 130–41

Developing Inquiry Skills

To compare alternative technologies for ameliorating environmental problems arising from dwindling energy resources and use of the automobile

On the basis of the evidence, to analyze the possible environmental impact of these technologies

Developing Learning Skills

To interpret diagrams showing the sequence of events in a process

To adapt one's reading rate to comprehend specialized vocabulary in context

Knowledge Goals

To understand technology as the use of human knowledge, skills, and tools in interactions with the environment

To conclude that there are both benefits and hazards in technological advances

To begin to evaluate new technologies on the basis of human priorities and conservation of a sanative environment

Clarifying Values

To consider the costs (in comfort, money, government controls) one is willing to assume in redirecting some technologies toward maintaining environmental quality

Developing a Positive Self-concept

To be willing to refine and enlarge one's views through a group exchange of ideas

Suggested Teaching Strategies	Possible Student Responses
"Man rushes first to be saved *by* technology, and then to be saved *from* it." These words of the writer Gerald Sykes might be written on the board and then interpreted by students in a brainstorming session answering the following questions: What is technology? What good things do you think of connected with the term technology? What negative things? All responses could first be listed on the board without discussion, without trying to evaluate	Three types of associations will probably be made with the word technology: manufactured things, including the human institutions producing them, such as factories, cities, assembly lines; interferences with the natural world, such as pollution; improvements of the natural world, such as medical technologies. Students begin to consolidate these various ideas within the concept of technology. They recognize that human

Suggested Teaching Strategies	Possible Student Responses
and eliminate any ideas. You can point out that the purpose of brainstorming is to help one another get ideas and to build on these ideas. A brief discussion of the values-clarification questions on textbook pages 131 and 140 could be initiated at this time.	beings have always used some form of technology (if only a rock thrown at a hunted animal). Once the technologies were simple and based on empirical, trial-and-error learning. Today, the power of technology to change the environment is based on scientific knowledge.
Upon what basic technologies does our current way of life depend?	Students can offer almost endless examples, including: technologies of energy conversion ("we burn coal to get electricity"); production techniques for extracting resources or for manufacturing goods; transportation; and, recently, the computer technologies, which have application to all other technologies.
What is the difference between the "technological solution" to world environmental problems and the "industrial growth solution"?	Developing countries often use the terms interchangeably, since the use of more technology accompanies industrial growth. However, as this case study reveals, the supporters of the technological solution value new technologies not so much for spurring economic growth as for making that growth less environmentally hazardous.
Students can now turn to the two case studies in the textbook, on pages 132–39. These case studies probe two technologies crucial to our present way of life—technologies of energy and transport.) Students prepared in advance could present graphic displays of the pro's and con's of each technology for class discussion: Another approach is to have a group of students present the advantages of each technology to the class as if enlisting funds for perfecting it. The class could act as the granting organization—perhaps a government committee or a large company—and challenge their position.	In presenting their case for each technology and in the challenges to it, students can include evidence from earlier case studies in the textbook as well as independently acquired data. For example, the case study "The Nuclear Power Station," on textbook pages 60–66, and the quotation by Garrett de Bell on page 68, can be brought to bear on the argument about nuclear reactors. Current newspapers and magazines like *Scientific American* can be gleaned for the latest innovations in these technologies.
You can broaden the discussion beyond these specific technologies by asking: In your opinion, what is the most serious environmental hazard facing us in the next thirty years? What technologies, if any, exist for control of this hazard? Students might be asked to review the computer forecasts on textbook pages 110–13. Which of the crises predicted by the study can be prevented by technology?	As students share their opinions, they may become aware that no single or small group of technologies is sufficient to protect the world environment. They may propose, instead, a new effort to use all technologies with foresight and consideration of their environmental consequences.

17 Equilibrium Society—A Solution?

Textbook pages 142–47

Developing Inquiry Skills

To test assumptions underlying the proposal for an equilibrium society

To probe the possible economic and sociological effects of an equilibrium society

To draw inferences about how an equilibrium society may affect the quality of life

Developing Learning Skills

To organize ideas in support of an expression of opinion

Knowledge Goals

To distinguish between a growing economy and a no-growth, or equilibrium, economy

To examine the claims of the supporters of the equilibrium society

To compare the proposal for an equilibrium society with alternative proposals for meeting environmental problems

Clarifying Values

To take a position on the extent to which one is willing to modify one's economic choices to conserve the environment

Developing a Positive Self-concept

To feel able to work with others in groups to consider various sides of an issue

Suggested Teaching Strategies	**Possible Student Responses**
You may wish to inform your students that the proposal for a so-called "equilibrium" or "no-growth" or "steady state" society seems Utopian and unworkable to most economists. However, it has gained the support of some economists (such as Kenneth Boulding) for at least one important reason. You might have students speculate as to the reason. Interested students might be referred to the *National Geographic* of July 1976 (pages 68–74), which refers briefly to the steady-state economy as one of the "outlines for the future." The rest of the issue is also useful in describing some of the environmental problems that supporters of the steady-state economy claim will be relieved by restricting growth.	Students may point out that the concept of an equilibrium society is helpful in focusing on the ecological dangers of continuing our present rate of growth. It also focuses our attention on the need for halting further erosion of the environment.
To begin, perhaps turn attention again to the computer forecasts on textbook pages 110–13. According to that study,	Each computer model predicted the eventual collapse of the world system. According to this study, if economic

Suggested Teaching Strategies	Possible Student Responses
what may happen if our present rate of economic growth continues?	growth continued, the world would not only run out of standing room for its people but would also run out of food and other resources needed for them. Moreover, pollution would destroy the quality of the air, water, and food needed to support life.
In what basic way does the equilibrium-society solution differ from the industrial and technological solutions?	The other solutions sanction economic growth while the equilibrium-society solution calls for a halt to economic growth. In the equilibrium society both population and wealth would be stabilized. Although the term wealth is often used in different ways, students can use it in this discussion as meaning the stock of material things with economic value. They can recognize that in the equilibrium society, the GNP, or gross national product, would need to remain relatively fixed rather than increase each year.
What claims are made for the equilibrium society by its supporters?	With population and wealth kept stable, the production of new goods can also be kept stable. This, say supporters, will check pollution and the drain on resources and minimize environmental deterioration.
How might life in an equilibrium society differ from life in an expanding, or growing, economy? Students could be divided into five groups to talk over and prepare reports that suggest differences between the two kinds of societies. Each group could compare the effects of both societies on one of these areas: individual rights; poverty and health; type of government; international relations; the major world environmental factors, such as pollution, resources, food production.	In their reports, students can treat some of the issues raised in the case study. Among these are: If industrial production is levelled off, will this mean job layoffs? If the total amount of goods remains fixed, how do deprived people get more of their needs met? Will decisions about distribution of the fixed supply of goods become a major social headache? Who will decide what specific goods and services to produce? In deciding, how do you evalute the damage to the environment and balance this against the value of the new goods and services you might want to produce? What political and economic institutions would be needed to keep population and wealth fixed? What, if anything, would be permitted to grow in the equilibrium society? (Some supporters speak of "redirecting growth" towards increasing services rather than goods.)
If you wish, you may conclude with the "Individual/Small Group Activity" on textbook page 147. Student	Students might weigh the implications of each "solution" for government, industry, environmental health, city and

Suggested Teaching Strategies	Possible Student Responses
interactions in this summary activity can be used to observe their competency in evaluating conflicting proposals for action.	country, the needs of different peoples, individual life styles and the quality of life (judged both generally and personally).

18 Values and the Human Role

Textbook pages 148–51

Developing Inquiry Skills

To hypothesize that different perceptions of the human role result in different behaviors toward the environment

Developing Learning Skills

To select or develop a statement expressing one's own view of the human role in the world environment

Knowledge Goals

To classify a variety of perceptions of the human role according to their impact upon the environment

Clarifying Values

To clarify and evaluate one's own view of the human role in terms of its impact upon the environment

Developing a Positive Self-concept

To be able to participate in reconciling diverse viewpoints for the common good

Suggested Teaching Strategies	Possible Student Responses
You might begin by having students apply the following questions to the quotations on textbook pages 149–51. What will the world be like in the year 2000 if we behave toward our natural environment as this person seems to suggest that we do? Is this the future you want for yourself in the year 2000?	Students infer the kinds of actions that stem from the attitude expressed in each quotation. They then explore the impact of those actions upon the environment. As students assert what they believe to be "positive" and "negative" impacts, they may get closer to their own unexpressed values. If desired, this activity can be carried out in small groups. Each group can devote itself to one quotation and develop its environmental implications in a report to the class.
Another approach is to have students choose the statement nearest to their own viewpoint, and explain why. They might modify the statement if need be, or write one from scratch. After each	Adolescents may be more concerned with characterizing themselves than with their "position statements." This concern can help reveal that each of us has a frame of reference from which

Suggested Teaching Strategies	Possible Student Responses
statement, students may characterize themselves briefly by either their current situation or anticipated one. A youngster might, for instance, describe herself as "chemical engineer, Monterey, California" in anticipation of her future career and residence.	environmental problems are viewed. They can probe what composes this frame of reference, pointing to goals, likes and dislikes, concepts, prejudices, and values arising from experience. They should note, also, that a person's frame of reference is not always obvious—as in Lindbergh's choice of birds over planes. Values are set, then, by more complex factors than just one's job.
The following question can underline the importance of frame of reference in values choices: How would people in the developing countries tend to react to the statements in the textbook? Which statements would be most likely to mirror their points of view?	In earlier case studies, students found that, in general, developing countries are still more concerned with such survival problems as getting enough food for their populations than preventing pollution. Those countries might therefore tend to agree with positions like those of Lawrence O'Brien, the Gould Company, or Professor Baxter. They might even stand the Thoreau quotation on its head, thus: What good is a tolerable planet if you haven't a house to put on it?
Do students see any way of reconciling the many different points of view toward the environment?	To state a point of view that they believe most of the world's peoples could agree upon, students might review statements in the textbook. Or they might themselves frame such a statement.
Perhaps write the words "cowboy" and "spaceman" on the board, pointing out that these labels have been applied (by the economist Kenneth Boulding) to two opposite approaches to the environment. The class could consider: How do you think each approaches the environment? Are their approaches different? If so, how? How would you classify the quotations in this case study? Which reflect the cowboy mentality, which the spaceman mentality? Which approach—that of cowboy, or that of spaceman—do you think is most needed today? Why? The quotation from Adlai Stevenson on textbook page 160 mirrors the spaceman point of view and might be examined at this time.	The cowboy ignored the environmental impact of his activities because he faced a seemingly endless frontier with vast resources. If grazing lands declined, he could move onward to new lands. Significantly, the conservation movement took shape in the late nineteenth century after the American frontier had "closed." The spaceman, on the other hand, knows that he lives in a closed system, and that whatever resource is used is gone forever unless recycled. Moreover, the waste-absorption capacity of the spaceship is also limited; therefore, whatever resource is used becomes a dangerous pollutant unless recycled. The spaceman mentality, applied to current environmental problems, conceives of the earth as a spaceship whose resources must be conserved and recycled to prevent both resource depletion and pollution.

19 What Can I Do?

Textbook pages 152–59

Developing Inquiry Skills

To analyze the effectiveness of possible actions to protect the world environment

Developing Learning Skills

To gather information for rational decision making

Knowledge Goals

To explore a variety of ways in which citizens can influence decision making on environmental issues

Clarifying Values

To debate the pros and cons of individual efforts to conserve the environment

Developing a Positive Self-concept

To be able to say, "I can help to protect the quality of the world environment"

Suggested Teaching Strategies	**Possible Student Responses**
One approach to this material is to put six columns on the board headed: Issue; Action; Environmental Outcome (of action); Would Take Action; Would Not Take Action; Why. Have students prepare similar columns in their notebooks and then consider each action described on textbook pages 153–58, filling in the columns. Each action could then be discussed by the class in terms of the same headings. After this discussion, you might ask whether any students have had a change of heart about their original responses in their notebooks. If they like, they might explain to the class how and why their attitudes toward certain of the actions changed.	Students express their opinions about each action in terms of their own backgrounds and value systems. Some students might tell of their experiences or the experiences of others with the kinds of issues and actions described. If a majority opinion arises toward some of the actions, this opinion might be debated with those holding the minority view.
In discussion of the action on page 154, students may be asked what they would like to know before making a decision to join that or any organization. The class could select about four or five environmental organizations about which they would like to find out more. (See NOTE on next page.) A class representative may either interview a member of that organization or review its literature.	Some aspects of each organization that students may decide to investigate are: When, why, and by whom was the organization formed? Have its position and activities remained consistent, or have these varied through the years? If so, how? By what methods does the organization try to influence environmental decisions? How effective is the organization? Students should compare their feelings about the organization *before* and *after* their investigation.

Suggested Teaching Strategies	Possible Student Responses
Discussion of the action on page 156 might be extended with the question: How else can individuals affect the political process to promote sound environmental decisions?	Students describe some of the ways in which citizens, as individuals and groups, can influence legislation. For example: voting; expressing their opinion to others to help gather support for their position; joining political parties or special-interest groups to spread their point of view and influence legislators more effectively; keeping track of the voting record of legislators on environmental issues and letting them know how they feel about the record; attending public hearings on a law being considered.
You might conclude by having students look through current newspapers to find out about legislation being contemplated. What is the possible environmental impact of such legislation? What groups seem especially active on this issue? How are these groups trying to gain support for their position?	Students can probably find a number of stories in the newspapers about both individual and organizational activities on laws affecting urban planning, the building of dams, the development of shoreways and highways, and, indeed, on any of the environmental issues presented in this textbook.
The epilogue, pages 160–61, might now be read aloud to the class by adept students, with time out for discussion of each point. As an ending to the program, the epilogue is most important in reminding students that the task of definition of the world they want to live in and the effort to get it remains largely with them.	The class could discuss, for instance; Can people "change their values?" Have we "tampered enough with nature and the world"? Are these "the goals of civilized people"? Only rigorous probing and discussion will develop the full meaning of these statements for students.

NOTE: Some of the environmental organizations that students may wish to explore are:

Conservation Foundation
1717 Massachusetts Avenues, N.W.
Washington, D.C. 20036

Defenders of Wildlife
1244 19th Street, N.W.
Washington, D.C. 20036

Environmental Action
Room 731
1346 Connecticut Avenue, N.W.
Washington, D.C. 20036

Friends of the Earth
529 Commercial Street
San Francisco, California 94111

Izaak Walton League of America
1800 North Kent Street
Suite 806
Arlington, Virginia 22209

National Audubon Society
950 Third Avenue
New York, New York 10022

National Parks Association
1701 18th Street, N.W.
Washington, D.C. 20009

National Wildlife Federation
1412 16th Street, N.W.
Washington, D.C. 20009

Sierra Club
530 Bush Street
San Francisco, California 94108

Wilderness Society
1901 Pennsylvania Avenue, N.W.
Washington, D.C. 20006

Zero Population Growth
1346 Connecticut Avenue, N.W.
Washington, D.C. 20036

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DUE EDUC NOV 26 '91
NOV 19 1991 RETURN
DUE EDUC OCT 15 '92
1992 OCT 09 RETURN
DUE EDUC NOV 16 '92
1992 NOV 17 RETURN
DUE EDUC OCT 0 [illegible]
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DUE EDUC NOV 29 '93
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